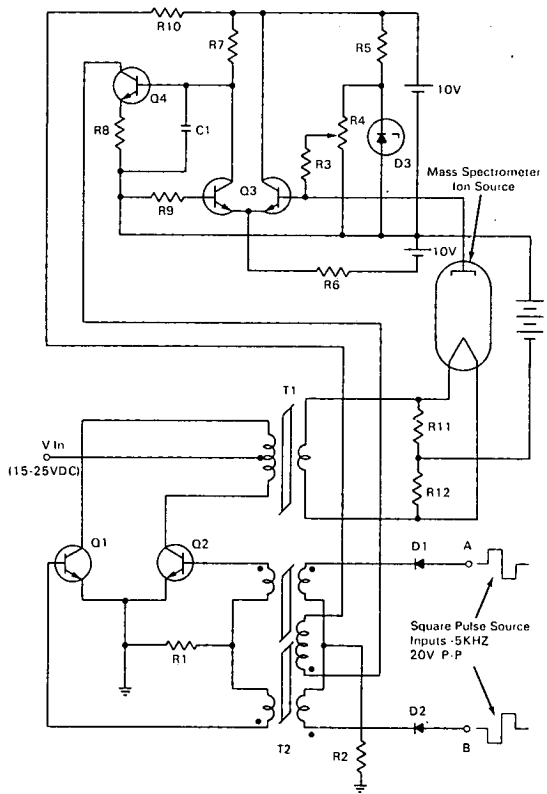
NASA TECH BRIEF

Magnetically Coupled Emission Regulator



Magnetically Coupled Emission Regulator

A new type high performance emission regulator has been developed which provides a constant current for ion sources. A magnetic amplifier provides dc isolation between input and output circuitry with a significant reduction in circuit complexity. This innovation has particular application in the design of electronic power supplies for use in mass spectrometers, vacuum ionization gages and similar instrumentation.

The problem:

The accuracy of analytical instrumentation employing constant current ion sources is critically dependent upon the degree of regulation of the emission current collected by the anode. Fluctuations of the current can occur as a result of supply voltage variations and changes in the emitter characteristics. Precise regulation is complicated by the requirement of controlling the current over several decades of

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dynamic range and the fact that the anode is at a high potential.

The solution:

High voltage isolation has been achieved through the use of magnetic coupling between input and power handling circuits. A feedback regulator, consisting of an error sensing amplifier and zener reference, samples the ion source bias current and provides deviation signals to a magnetic amplifier pulse modulator, the pulse modulator controls the dc to ac power inverter which in turn, controls the emission current.

How it's done:

Drive voltages (20 volts peak-to-peak at 5 kHz) are applied to the primary of the magnetic amplifier T2, through blocking diodes D1 and D2. The secondaries bias transistor power switches Q_1 and Q_2 "on" for equal periods determined by the pulse source; the length of the equal on periods is determined by the amount of current from the error amplifier, $Q_3 - Q_4$, which flows through the magnetic amplifier control winding. The input to the isolated error amplifier is derived from the voltage difference between the zener diode D3 and the voltage across R3 caused by the electron collector current. As a function of this control current, the magnetic amplifier will go into saturation at some point during either half-cycle period. The inrush of current through the primary increases the voltage drop across R2 which reduces the primary voltage, the secondary voltage is thus reduced until the appropriate power switch is turned off.

The phasing of error correction loop is such that an increase in current (appearing as a negative going voltage at the junction of Q3 – R3) tends to cause a decrease of the "on" periods of the power switches.

Power transfer efficiency has been measured at 93% with a 2.5 ampere filament load. The regulator, as designed, can handle filament currents up to 3 amperes. The emission current can be regulated from 10 μA to 100 μA with a total regulation error of 0.1%.

Notes:

1. No further documentation is available. Inquiries may be directed to:

Technology Utilization Officer
Goddard Space Flight Center
Greenbelt, Maryland 20771
Reference: B69-10213

Patent status:

No patent action is contemplated by NASA.

Source: Consultants and Designers
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